

CLAIMS

We claim:

- 1 1. A liquid crystal device comprising:
 - 2 a pair of opposed substrates having a gap therebetween;
 - 3 a liquid crystal material disposed in said gap; and
 - 4 polymer micro-structures formed between said substrates, wherein the
 - 5 micro-structures are formed by polymerizing a prepolymer, and wherein the
 - 6 micro-structures have a shape and spatial location determined by the director
 - 7 field of said liquid crystal material.
- 1 2. A liquid crystal device according to claim 1, wherein said microstructures are
 - 2 affixed to said at least one of the substrates.
- 1 3. A liquid crystal device according to claim 1, additionally comprising an
 - 2 alignment layer disposed on at least one of said substrates.
- 1 4. A liquid crystal device according to claim 3, wherein said alignment layer is
 - 2 selected from the group consisting of polymers, silicon oxide layers and
 - 3 surfactants.
- 1 5. A liquid crystal device according to claim 3, wherein said alignment layer
 - 2 produces a homogeneous planar geometry of the director field.
- 1 6. A liquid crystal device according to claim 3, wherein said alignment layer
 - 2 produces a homogeneous tilted geometry of the director field.
- 1 7. A liquid crystal device according to claim 3, wherein said alignment layer
 - 2 produces a homeotropic geometry of the director field.

- 1 8. A liquid crystal device according to claim 3, wherein said alignment layer
2 produces a patterned geometry of the director field with different alignment
3 properties at different regions of the cell
- 1 9. A liquid crystal device according to claim 1, wherein said liquid crystal
2 material is selected from the group consisting of nematic liquid crystal
3 material, cholesteric liquid crystal material, smectic liquid crystal material and
4 columnar liquid crystal material.
- 1 10. A liquid crystal device according to claim 1, wherein said prepolymer is
2 selected from the group consisting of UV-curable prepolymers and heat-
3 curable prepolymers.
- 1 11. A method for fabricating a liquid crystal device having polymer micro-
2 structures, the method comprising the steps of:
3 preparing a mixture comprising a liquid crystal material and a
4 prepolymer;
5 providing a first and second cell wall structure, said first and second
6 cell wall structures optionally having electrodes disposed on facing sides of
7 said first and second cell wall structures, and, optionally having an alignment
8 layer disposed on at least one of said electrodes;
9 disposing said mixture into a space between the first and second cell
10 wall structures;
11 causing said liquid crystal material to assume a predetermined
12 orientation with a non-uniform spatially distorted director field; and
13 exposing said mixture to conditions which cause polymerization of the
14 prepolymer and formation of polymer microstructures between the cell walls.
- 1 12. A method for fabricating a liquid crystal device having polymer micro-
2 structures according to claim 11, wherein said mixture comprising a liquid

3 crystal material and a prepolymer comprises between about 0.1 percent
4 and about 50 percent prepolymer.

1 13. A method for fabricating a liquid crystal device having polymer micro-
2 patterns according to claim 11, wherein said liquid crystal material is
3 selected from the group consisting of cholesteric liquid crystal material,
4 nematic liquid crystal material, columnar liquid crystal material and
5 smectic liquid crystal material.

1 14. A method for fabricating a liquid crystal device having polymer micro-
2 patterns according to claim 11, wherein said prepolymer is selected from
3 the group consisting of UV-curable prepolymers and heat-curable
4 prepolymers.

1 15. A method for fabricating a liquid crystal device having polymer micro-
2 patterns according to claim 11, wherein said first and second cell wall
3 structures have electrodes disposed thereon, and wherein said step of
4 causing said liquid crystal material to assume a predetermined orientation
5 with a non-uniform spatially distorted director field comprises applying a
6 voltage across said electrodes.

1 16. A method for forming polymer micro-structures, the method comprising the
2 steps of:
3 preparing a mixture comprising a liquid crystal material and a
4 prepolymer;
5 providing a first and second cell wall structure;
6 disposing said mixture into a space between the first and second cell
7 wall structures;
8 causing said liquid crystal material to assume a predetermined
9 orientation with a non-uniform spatially distorted director field; and

10 exposing said mixture to conditions which cause polymerization of the
11 prepolymer and formation of polymer micro-structures between the cell walls.

1 17. The method for forming polymer micro-patterns according to claim 16,
2 wherein the curable prepolymer is a UV-curable prepolymer and wherein the
3 step of exposing the mixture to conditions which cause polymerization of the
4 prepolymer comprises exposing the prepolymer to UV radiation.

1 18. The method for forming polymer micro-patterns according to claim 16,
2 wherein the first and second cell wall structures additionally comprise
3 electrodes disposed on facing sides of said first and second cell wall
4 structures.

1 19. The method for forming polymer micro-patterns according to claim 16,
2 wherein at least one of said first and second cell wall structures additionally
3 comprise an alignment layer disposed thereon.

1 20. The method for forming polymer micro-patterns according to claim 16,
2 wherein said mixture comprising a liquid crystal material and a curable
3 prepolymer comprises between about 0.1 percent and about 50 percent
4 curable prepolymer.

1 22. The method for forming polymer micro-walls according to claim 16, wherein
2 said liquid crystal material is selected from the group consisting of nematic
3 liquid crystal material, cholesteric liquid crystal material, columnar liquid
4 crystal material and smectic liquid crystal material.

1 23. A method for forming a liquid crystal cell comprising the method for forming
2 polymer micro-patterns according to claim 16.

1 24. A liquid crystal cell formed by the method of claim 16.